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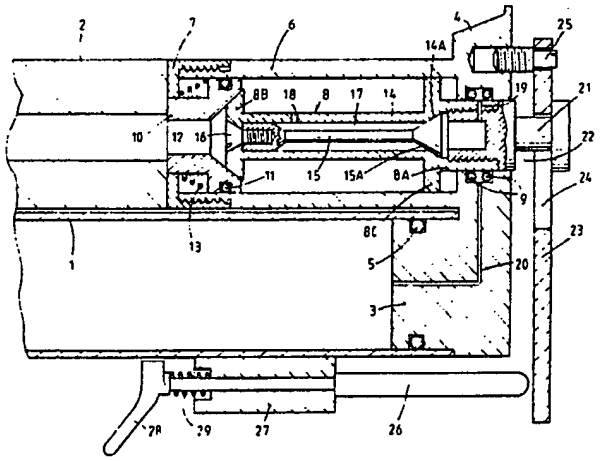
(54) Discharge valve arrangement

(57) A discharge valve arrangement for air guns comprises a resilient valve member (8) having a valve head (8B) closing a discharge orifice (12) to the gun barrel and a valve stem (8A) slideable in a bore sealed by O rings (9). The effective diameter of the head (8B) is greater than that of the stem (8A) so that the valve is held closed by gas pressure applied between the head and stem, but can snap open when the valve head is displaced from its seat by operation of trigger 28 causing a lever 28 to pivot. The cylinder 6 is charged with air from cylinder 1 by pushing the valve member 8 forward at plug 21 to open a passage 20, 19, 17, 18. The effect of pressure in opposite directions on head 8B and stem 8C tensions the resilient valve member 8, so that, at a predetermined pressure, the valve head 15A on a rigid core 15 engages a seat 14A on the member 8 to prevent further passage of air to cyinder 6.



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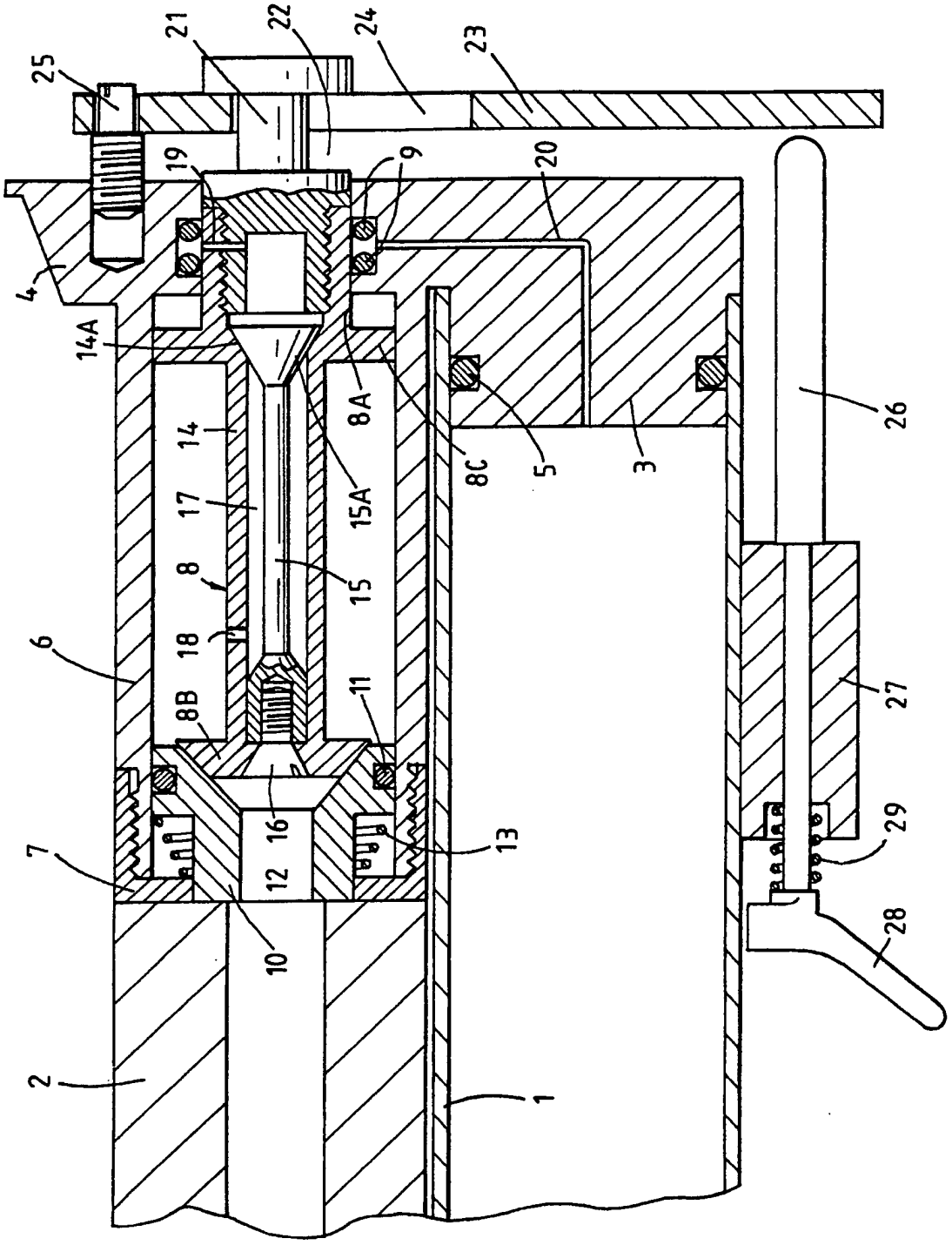
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982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AIR DISCHARGE VALVE

This invention relates to a gas discharge valve arrangement intended for the rapid discharge of a measured quantity of gas, and has application more especially but not exclusively in airguns of the pneumatic type.

In accordance with one aspect of the invention a gas discharge arrangement comprises a reservoir for storage of a pressurised gas, a metering chamber having a given volume and coupled to said reservoir via a control valve, said metering chamber having a gas discharge orifice and a further orifice, a gas discharge valve having a valve head arranged to engage a valve seat to close said discharge orifice and a valve stem slidably engaged in said further orifice and sealing the latter, the arrangement being such that when said metering chamber is charged with gas at a pressure substantially higher than that prevailing outside said orifices an axial thrust is exerted upon said valve member maintaining sealing engagement between said valve head and the valve seat, and an actuating means being provided for displacing the valve member axially to break the seal between the valve head and the valve seat for discharge of gas from the metering chamber.

Advantageously the valve head is arranged to engage the valve seat on the upstream side of the valve seat. In this case the thrust force acting upon the valve member due to the cross sectional area of the valve stem tends to aid the opening movement of the valve as soon as the pressure drop across the valve head is reduced, promoting a "snap action" of the valve that is particularly suitable for the discharge of gas from a pneumatic airgun.

In a particularly advantageous embodiment of the invention the said valve stem is resiliently movable relatively to the valve head under the influence of gas pressure within the said metering chamber, such movement being effective to close said control valve at a predetermined pressure within the metering chamber. Such resilient movement of the valve stem can be achieved in a particularly simple manner by forming the valve member integrally from a suitable resilient synthetic plastics material. The said control valve can also be incorporated in the valve member very simply if the valve member is formed as a hollow member within which is anchored a relatively more rigid element extending coaxially therein to define a valve orifice that becomes closed upon resilient extension of the hollow valve member.

According to a further preferred feature of the invention, the said control valve, or a further control valve, is actuated in accordance with the axial position of the said valve member, whereby said metering chamber is isolated from said reservoir when the valve member is in the open position.

According to a yet further preferred feature of the invention, when incorporated in an airgun, the said metering chamber is located directly behind the barrel of the gun, and the valve seat engaged by the head of the valve member is formed in a piston member displaceable in a bore defining the metering chamber and arranged to be urged under the pressure of gas within the metering chamber towards the rear end of the barrel in order to maintain a

seal between the metering chamber and the bore of the barrel during discharge of gas therethrough.

Further preferred features of the invention will become apparent from the following description and accompanying drawing, the single figure of which is a part sectional elevation, in diagrammatic form, of an airgun incorporating a discharge valve according to the invention.

Referring to the drawing, an airgun of the kind referred to as a "precharged pneumatic" comprises an air cylinder 1 above which is mounted the barrel 2 of the gun. The rear end of the cylinder 1 is closed by means of an end plug 3 forming part of a breech block 4 of the gun. The end plug 3 carries an o-ring 5 which seals the cylinder 1, and is secured in the latter in such a manner that it is axially fixed but is pivotable about the axis of the cylinder 1 through a limited arc of movement. The breech block 4 carries a cylinder 6 that extends forwardly above the cylinder 1 and the forward end of which is provided with a screw threaded end cap 7. Within the cylinder 6 is provided a valve member indicated generally by the numeral 8 the rear end of which comprises a valve stem 8A that is sealed within the rear end of the cylinder by a pair of o-rings 9 and the front end of which comprises a valve head 8B that makes sealing engagement with a valve seat formed upon an annular piston member 10 slidable within the cylinder 6 and retained in place by the end cap 7. The piston member 10 carries an o-ring 11 sealing the piston member 10 within the cylinder 6. The forward end of the piston member 10 projects through the end cap 7 and can make sealing engagement with the rear end of the barrel 2. A bore 12 of the piston member 10 serves to couple the cylinder 6 to the bore of the barrel 2 when the valve head 8B is disengaged from its valve seat, and a compression spring 13 is

arranged between the end cap 7 and the piston member 10 in order to urge the latter rearwardly.

The valve member 8 is formed as a composite of an outer sleeve portion 14 consisting of a resiliently extensible synthetic plastics material such as Nylon or Nylatron and incorporating the valve head 8B and the valve stem 8A and a rigid core 15, for example of brass, anchored to the sleeve 14 at the forward end, for example by means of a securing screw 16. The rearward end of the core 15 is shaped to form a conical valve head 15A arranged to engage a corresponding valve seat 14A formed within the rear part of the sleeve 14. Between the sleeve 14 and the core 15 there is defined an annular passage 17 that communicates with the cylinder 6 via one or more radial apertures 18 in the sleeve 14. To the rear of the valve seat 14A the sleeve 14 has a radial bore 19 that, in the position of the valve member 8 shown in the drawing, lies in the space between the o-rings 9. This space is also coupled to the interior of the cylinder 1 by way of a conduit 20 formed in the end plug 3 and the breech block 4. The rear end of the valve member 8 is closed by an end plug 21 so that the passage 17, the aperture 18 and the bore 19 provide a fluid tight coupling between the cylinders 1 and 6.

The rear end of the end plug 21 has an annular groove 22 that engages with a lever member 23, for example by means of a keyhole slot 24 formed in the lever member 23. The lever member 23 engages loosely over an end of an adjusting screw 25 threaded in the breech block 4. The screw 25 thus forms a fulcrum for the lever member 23 and also allows adjustment of the idle position thereof.

Below the cylinder 1 a push rod 26 is slidably guided in a

bushing indicated diagrammatically at 27 and fixed with respect to the cylinder 1 in a manner not shown. The left hand end of the push rod 26 as viewed in the drawing carries a trigger member 28 and the trigger and push rod are lightly return spring loaded into the left hand end position by a compression spring 29. When the trigger member 28 is depressed against the spring loading, the end of the push rod 26 can engage and displace the free end of the lever member 23.

The operation of the device described above is as follows. In the idle condition the piston member 10 and the valve member 8 are urged rearwardly by the spring 13 so that the bore 19 lies outside the space between the o-rings 9 and the conduit 20 from the cylinder 1 is closed. The cylinder 6 is at atmospheric pressure. In this condition the breech block 4 can be swung about the axis of the cylinder 1 to free the rear end of the barrel 2 for loading with an airgun pellet. After returning the breech block to the position behind the barrel 2, the valve member 8 is pushed forwards by manual pressure on the end plug 21. This brings the bore 19 into position between the o-rings 9 and thus into communication with the cylinder 1. Assuming that the cylinder 1 is charged with air at high pressure, air will pass from the bore 19 past the valve head 15A and via the passage 17 and aperture 18 into the cylinder 6. The effective area of the valve head 8B engaging the valve seat in the piston member 10 is greater than the cross-sectional area of the valve stem 8A and therefore as the cylinder 6 becomes pressurised with air, not only is the piston member 10 forced forwardly into sealing engagement with the barrel 2, but the valve head 8B is also forced into tighter engagement with the valve seat to maintain a fluid tight seal of the cylinder 6. Initially the sleeve member 14 is relaxed so that an axial space exists between the valve

head 15A and the valve seat 14A, but as the cylinder 6 becomes charged to a higher pressure the sleeve portion 14 becomes tensioned because of the air pressures acting in opposite directions on the valve head 8B and the valve stem 8A and is thus elastically extended. Therefore at a predetermined pressure within the cylinder 6 the valve head 15A will meet the valve seat 14A and prevent further air from passing from the cylinder 1 to the cylinder 6. The maximum pressure within the cylinder 6 is thus independent of the pressure prevailing within the cylinder 1. Once this point has been reached further resilient extension of the valve member 8 cannot occur, since the sleeve 14 and the core 15 form a rigid unit.

When the airgun is to be fired pressure upon the trigger member 28 causes the lever member 23 to be pivoted about the fulcrum provided by the screw 25, thus drawing the valve member 8 rearwardly via the end plug 21. It is only necessary for the valve member 8 to be displaced very slightly away from the valve seat in the end plug 10 so that the pressure drop across the head of the valve member 8 is reduced to the point at which the tension on the valve stem 8A exceeds that on the valve head 8B, whereupon the valve member 8 will be caused to snap rearwardly allowing rapid dumping of air from the cylinder 6 to the barrel of the gun. In practice this action gives to the user of the airgun the sensation of a very smooth yet positive trigger release.

As the valve member 8 moves rearwardly the bore 19 moves out of the space between the o-rings 9 so that the cylinder 6 is cut off from the cylinder 1 during the discharge of air. The rearward movement of the valve member 8 may be limited, for example by a collar 8C formed integrally therewith, so that in the rearmost position of the valve

member 8 the bore 19 remains within the bore of the breech block 4 to impede any escape of air therefrom during discharge of air from the cylinder 6. After this discharge is complete the piston member 10 is returned by the compression spring 13 into engagement with the valve head 8B and the system is thus restored to the idle condition.

It will be appreciated that modifications may be made to the above described arrangement without departing from the scope of the invention claimed. Thus the valve seat for the valve head 8B may be arranged on the downstream side of the piston member 10, with the valve stem 8A then being of greater cross-sectional area. Since the valve will then lose its "snap" action a more conventional impact actuating mechanism may be arranged to open the valve by a hammer acting on the rear or the end plug 21. Also the valve for isolating the cylinder 6 may then be coupled, for example, to the hammer in such a manner that the cylinder 6 becomes coupled to the cylinder 1 via the valve 8 upon cocking of the hammer.

If desired an alternative material may be selected for the sleeve 14 in order to obtain tha optimum elastic modulus.

An arrangement as described will be seen to provide numerous advantages over hitherto known arrangements. Thus the valve member 8 is a self contained unit that functions both as the gas discharge valve and as pressure control valve for the gas metering chamber and is simple and inexpensive to construct. The sleeve 14 may, for example be injection moulded from appropriate synthetic plastics material. Moreover when the gas pressure to be controlled by the valve is required to be set accurately, for example so that the power of the airgun is within legal requirements, this can be achieved by adjustment of the

dimensions of the valve unit 8 in manufacture and the calibration of the valve unit 8 can then be tested separately from any airgun in which it is to be incorporated. Such valve units are also readily removed from and replaced in the airgun simply by removing the front end cap 7 whilst the breech block 4 is swung clear of the barrel 2. Thus the user of the airgun can conveniently vary the power of the airgun by interchanging valve units suitably calibrated in manufacture, or attend to replacement of faulty or leaking valves.

CLAIMS

1. A gas discharge arrangement comprising a reservoir for storage of a pressurised gas, a metering chamber having a given volume and coupled to said reservoir via a control valve, said metering chamber having a gas discharge orifice and a further orifice, a gas discharge valve having a valve head arranged to engage a valve seat to close said discharge orifice and a valve stem slidably engaged in said further orifice and sealing the latter, the arrangement being such that when said metering chamber is charged with gas at a pressure substantially higher than that prevailing outside said orifices an axial thrust is exerted upon said valve maintaining sealing engagement between said valve head and the valve seat, and an actuating means for displacing the valve axially to break the seal between the valve head and the valve seat for discharge of gas from the metering chamber.

2. An arrangement as claimed in claim 1, wherein the valve head is arranged to engage the valve seat on the upstream side of the valve seat.

3. An arrangement as claimed in claim 1 or 2 wherein the said valve stem is resiliently movable relatively to the valve head under the influence of gas pressure within the said metering chamber, such movement being effective to close said control valve at a predetermined pressure within the metering chamber.

4. An arrangement as claimed in claim 3 wherein said valve comprises a valve member formed integrally from a suitable resilient synthetic plastics material.

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